

CONVERSION OF ORGANIC FOOD WASTE INTO USEFUL BIO-FUEL THROUGH ANAEROBIC DIGESTION

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ABSTRACT

Food, Shelter, Clothes are the basic needs for human survival, in which food is fundamental need to keep humans alive. For that food is generated on large scale and further creates huge waste. Food waste or food loss is, food that is discarded or uneaten. Food waste is something that affects us all. It happens anywhere like Grocery store, Restaurants, Houses, Schools, Farms, etc. The amount of food waste generated in India is approximately 68 Million Tonnes annually. India is a country in which many people do not have enough to eat. Around the world 5 Million children die each year because of hunger and lack of enough food. To avoid these things people should stop wasting food, so that there is enough food for everyone and government can make it possible for all to eat. The food which is wasted, is transferred to dumping lands for the degradation. The dumping of organic waste leads to formation of leachates in the land, it also affects the environment by emitting gases which leads to the depletion of Ozone layer and have ill effects to the atmosphere. A good solution to prevent dumping and disposal of food waste is conversion of organic food waste into usable Bio-fuels in day to day life. Such as, fuel for transportation and household purposes in various forms of gases. It can be done by Aerobic and Anaerobic digestion of food waste. Anaerobic Digestion is a process in which Micro-organisms breakdown bio-degradable material in the absence of oxygen. The bacteria present in the digester converts organic acids into acetic acids along with additional ammonia, hydrogen and carbon dioxide. Finally Methanogens converts these products into Methane (CH₄) and Carbon Di-oxide(CO₂).

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I. INTRODUCTION

The increasing industrialization and motorization of the world has led to a steep rise for the demand of petroleum-based fuels. Today fossil fuels take up 80% of the primary energy consumed in the world, of which 58% alone is consumed by the transport sector. The sources of these fossil fuels are becoming exhausted and found major contribution in greenhouse gas (GHG) emissions by consumption of fossil fuels to fulfill the energy demand, which leads to many negative effects including climate

change, receding of glaciers, rise in sea level, loss of biodiversity, etc. Increasing energy demand leads to an increase in crude oil price, directly affected to global economic activity. Progressive depletion of conventional fossil fuels with increasing energy consumption and GHG emissions have led to a move towards alternative, renewable, sustainable, efficient and cost-effective energy sources with lesser emissions. Huge quantities of food waste is generated worldwide and currently its disposal is becoming a challenge. Food waste causes economic and environmental problems. Currently, most food waste is

land-filled or incinerated for possible energy recovery. However, these methods have serious adverse effects on the environment. We are developing a process design that offers a gas processing technology through our Food Waste to Energy. We contribute its share in saving nature with the help of technology by recycling organic waste and converting it to usable fuel. The waste we are using for treatment will be Canteen waste from our college which will give a solution to the food waste generated, reducing the disposal and transportation cost.



Fig no 1. Food Waste

Problem Statement:

- Treating the food waste in an efficient way which is generated on large amounts.
- The use of fossil fuels is increasing.
- Depletion of Environmental factors due to dumping of organic waste for degradation.

Objectives:

- To treat the organic food waste generated by the college canteen into a profitable and usable Bio-fuel.
- To achieve economy by reducing the cost of disposal of the food waste and reducing the pollution.
- To generate methane gas from the toxic food waste which can be further converted into a energy form.

Scope of Project:

India, the second most populated country after China is one of the largest emitter of greenhouse gases (GHG). Hotels and Canteens are massive producers of food waste so it is very important to work on food waste management .Transport sector of India accounts to 13 percent energy-related carbon-dioxide emissions for the disposal of the food waste. So to provide solution to the canteen food waste we are preparing an Anaerobic Digester which will generate ethane gas which can be used as fuel for cooking food in canteen is obtained.

II. LITERATURE SURVEY

1. According to Wei Su, Ming Gao, Hong Zhi at all the food waste produced can be converted into a fuel by multiple processes. In 2010 they submitted the report to The Department of Environmental Engineering School Of Civil and Environmental Engineering, University Of Science and

Technology Beijing, China. The Title of their project was “Research On Bio-diesel And Ethanol Production From Food Waste”. It Incorporated of two processes viz. Chemical Synthesis for Bio-diesel production from oil of vegetables and Ethanol production for the solid parts of the food waste by closed chamber fermentation. The research proved that Bio-diesel incurred from vegetable oil was more efficient and economical according to the cost and pollution measures.

2. The Article published by Sanjib Kumar Karmee and Carol Szi Ki Lin in 2014 studied on “Valorization Of Food Waste To Bio-fuel”. The paper was acknowledged by The School Of Energy And Environment, City University Of Hongkong, Tat Chee Avenue, Hongkong. The paper premeditated the effects of the food waste that goes into landfills and pollute the water table and can form leachetes after rainfall, So the paper gives solution to the food waste which is a zero cost product into bio-fuels. They researched on increasing the yield of ethanol production by using lipids and carbohydrates present in the food waste.

3. The Article published by Jilu Lizy Stephan, Bala Subramaniam Periyasamy, on 14 November 2017 studied “Innovative Developments in bio-fuels production from organic waste materials” and the research was accepted by School of engineering and physical Sciences, Heiroit - Watt University, Dubai Campus. United Arab Emirates. To circumvent the problem of processing organic waste strong legislative policies for improving waste collection and storage system was necessary to be adopted. This research included prominent intensification technology which used micro wave reactors which added up to the efficiency of bio-diesel production. A high yield was obtained just in less than 2 minutes of time in the reactor. The activated carbon enhanced the heating rate and provide better pyrolysis and cracking rate. As compared to many other researchers who had successfully processed intensification, the method used by above mentioned researchers was - centrifugal contractor for bio-diesel production which showed excellent results.

4. In November 23 2005, Mustafa Canakci researched on “The Potential Of Restaurant Waste Lipids As Bio diesel Feed stocks” which was submitted to Department of Mechanical Education, Kocaeli University, Umuttepe, Turkey, it considered the ready availability and the properties of restaurant waste oil and rendered animal fat as low cost feed stocks for bio diesel production. The researchers focused on the use of rendered animal fats and restaurant wastes oils as a bio diesel. To prepare esters with a high yield using alkaline catalysis, it is necessary for the feed stocks to have low acid value. The process includes transesterification after addition of water using Acid catalyzed process (to neutralize the acidic functional groups present in a sample using Potassium Hydroxide as catalyst).

5. In India, “Food Waste Management: Study of Indian Hotel Industry”, Dilbag Singh (2018), states in their study that restaurants are one of the major waste producers in the field of commercial kitchen. Mass Production of food waste from hotel industry is such a big challenge, so there is a huge requirement to develop a holistic framework for waste

management. In hotel industry most of the food wastes are compostable. The present study is an attempt to show that an effective waste management not only helps the organization to work for an eco-friendly environment but also helps them to earn profit out of it. . The present study not only helps the hotels to adopt an effective waste management but also helps the researchers to work in the concern field by providing AD for treating the food waste of hotels into bio-fuel which can be used as option for buying artificial gas i.e. Recycle.

6. The Article “Bio-fuel production and implications for land use, food production and environment in India” presented by N.H. Ravindranath, C. Sita Lakshmi, Ritumbra Manuvie, P. Balachandra accepted on 25 July 2010 by The Center for Sustainable Technologies, Indian Institute of Science, Bangalore 560012, India. They inclined that Indians are consuming 156 Million barrels of crude oil and 6 Million barrels may increase every day till 2030, due to this countries like India are opening towards Bio-fuels than Petroleum fuels. In this paper an attempt was made to analyze the implication of potential bio-fuel program from the Social, Economic and Environmental perspective. They used varied products for the production of bio-fuel by using multiple methods of decomposition, Such as Sugar Crops, Starchy Crops, Cellulosic materials and Oil crops. The methods of incurring bio-fuels from these products were Fermentation and Distillation, Saccharification and Fermentation, Extraction and Esterification.

7. As reported by Jian Hou, Peidong Jhang, Xianzheng Yuan, Yonghong Zheng in “Life Cycle Assessment Of Bio-diesel From Soybean, Jatropha And Micro-algae In China Condition” to Qingdao Institute Of Bio-energy And Bio-process Technology, Chinese Academy Of Sciences, Shandong Province, Qingdao, China Graduate University Of Chinese Academy Of Sciences, Beijing, China. The Research paper was accepted on 5 July 2011 which stated that, In the year 2009 consumption of crude oil reached away its level which resulted in the increasing demands of the fuels and price of crude oil. To provide the best solution to this problem they gave a method of using Soybean Oil, Jatropha Oil and Microalgal oil for the production of transportation fuel. They also analyzed that the usage of Bio-diesel in China will amount to 0.2 million tonnes in 2010 and 2.0 million tonnes till 2020.

8. The Article is Published by Vishal Thakur on 30 July 2016 “Bio-diesel - An Alternative Method For Energy Crisis” which was submitted to Biotechnology In Energy ONGC Energy Centre, Delhi New, India. He stated that in the present times almost half of the world’s population, especially in rural areas depend on bio-fuels to prove cooking energy. Transesterification of vegetable oils using enzymatic mode is preferred because of their low cost and simple method for the synthesis of bio-diesel. Apart from that they have similar process for modules when using refined vegetables oil including oil degumming, transesterification and product purification. finally with new technologies or products bio-diesel will require continuous improvement especially in cleaner emissions and having less impact on the environment.

9. In “Food waste : Potential source for bio-energy and bio-product” published in April 2017 by Veronica Batori, Lukitawesa, Ramkumar Nair, they have studied that due to inefficiency of food supply chain(FSC) 1/3rd of food is wasted every year. The total food waste produced in European countries counts to 42%. In this paper Resource recovery has been accepted by bio-refiners that use organic food waste for production of Bio-based products. Sustainable resources recovery for efficient food waste management is a most environment healthy, Socio-economic process too.

10. The paper “Butanol production from food waste: A novel process for producing sustainable energy and reducing environmental pollution”, by Haibo huang, Vijay Singh, Nasib Qureshi published in 2015 and submitted to Department Of Agricultural and Bio logical engineering, University of Illinois at Urbana, USA. They studied the byproducts incurred by processing of food waste that are Butanol, Ethanol and Methanol have different methods for the degradation of food waste. The methods used were to check the most efficient process to acquire 100% results.

III. METHODOLOGY

There are various methods of conversion of food waste into usable bio-fuels. The various methods used are-

1. Anaerobic Method :-

Anaerobic digestion is the process by which organic matter such as animal or food waste is broken down to produce biogas and bio-fertilizer. This process happens in the absence of oxygen in an oxygen-free tank.

2. Aerobic Method :-

The method in which organic matter or organic waste is breakdown to produce bio-gas or bio-fertilizer in presence of oxygen in an open digester is called as aerobic digestion.

From the above methods we have focused on the treatment by Anaerobic Digestion. The Methodology includes the operation and process used for Anaerobic Digestion which are shown in the following Figure 3. The flowchart diagram is also shown for the same.

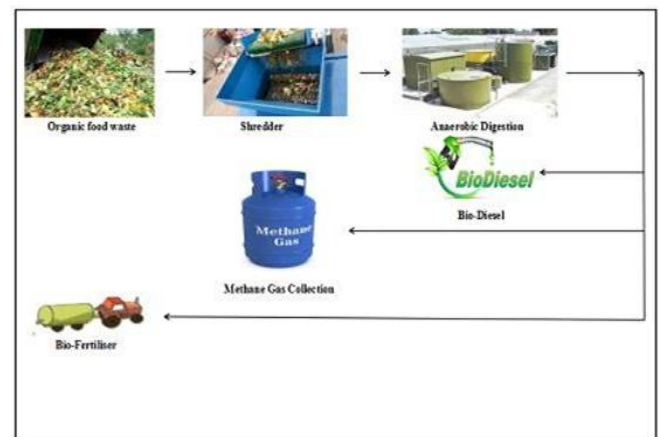


Fig. No 2. Layout of Anaerobic Digester

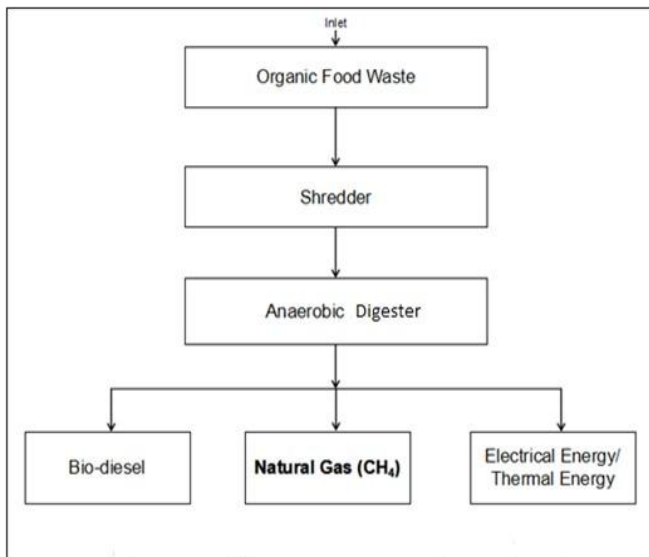


Fig 3. Flow diagram of Anaerobic Digester

IV. FABRICATION DESIGN

The fabrication for the model consisted of a plastic tank approx. 0.2 m³ for the digester where the food is digested and gas is produced in the same digester. A shredder is attached to the digester with a valve for insertion of food. An outlet for the produced gas is fixed with the help of m-seal so as to make the tank air tight.

The shredder is made of Mild Steel of grade 302 which were laser cut for appropriate size and perfect cut. It consisted of blades and side panels for fixing the blades. The whole assembly of shredder is fixed by using nut and bolts.

A valve is provided at bottom of the tank so as to drain out the digested waste after digestion process, the valve fitting is of high grade plastic so the digested waste will not affect the valve.

Following are the photographs of the fabrications made for the model:-



Fig 4. Fabrication design

V. CONCLUSION

Since food waste is considered zero cost material it is possible to develop cost-effective commercial methods for

the production of bio-fuel using lipid and carbohydrate generated from food waste. Research on the conversion of food waste into bio fuel will provide an innovative food valorization strategy; which could contribute substantially to bio-based economy

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